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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/027,462	12/21/2001	Leonid Yaroslavsky	10010525-1	1553

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EXAMINER	
SETH, MANAV	
ART UNIT	**PAPER NUMBER**
2624	

DATE MAILED: 06/07/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	**Application No.**	**Applicant(s)**	
	10/027,462	YAROSLAVSKY ET AL.	
	Examiner	**Art Unit**	
	Manav Seth	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 May 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-12 and 14-35* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *5-9,15-20,34 and 35* is/are allowed.

6)☒ Claim(s) *1,2,10-12,21,23,25-27 and 30-33* is/are rejected.

7)☒ Claim(s) *3,4,14,22,24,28,29* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. The amendment received on May 15, 2006 has been entered in full.

2. Applicant's arguments with respect to rejected claims as presented in the amendment filed have been fully considered but are moot in view of new ground(s) of rejection(s).

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1, 21 and 26 are rejected under 35 U.S.C. 102(b) as being anticipated by Kitamura, U.S. Patent No. 5,369,430.

Claim 1 recites a method of automatically focusing an imaging system on an object comprising: using either

(a) **a comparison between an image of a typical object and the image of the object created by the imaging system,** or (b) **an edge density in an image of the object and the comparison,** to determine an optimum focus position.

As the claim 1 recites using one alternative to determine an optimum focus position, examiner selects **(a) a comparison between an image of a typical object and the image of the object created by the imaging system to determine an optimum focus position**, to reject the claim 1. Kitamura discloses an image of a typical object (reference image pattern – which is not being imaged by the imaging system but is pre-stored) (col. 2, lines 64-68) and further discloses a comparison between an image of a typical object and the image of the object created by the imaging system to determine an optimum focus position (col. 3, lines 1-20; col. 2, lines 1-16; figure 1).

Regarding claim 21, Kitamura discloses an imaging system that recites a memory, program (inherent to be used by CPU) and a CPU (controller) (col. 5, lines 10-45). All other limitations have been similarly analyzed and rejected as per claim 1.

Regarding claim 26, Kitamura discloses an imaging system that recites a memory, program (inherent to be used by CPU) and a CPU (controller) (col. 5, lines 10-45). All other limitations have been similarly analyzed and rejected as per claim 1.

5. Claims 10-12 and 31-33 are rejected under 35 U.S.C. 102(b) as being anticipated by Zwirn et al., U.S. Patent No. 4,789,898.

Regarding claim 10, Zwirn teaches comparing video image signals (control signals), which are related to image characteristics such as edge density to determine an optimum focused image (col. 2, lines 20-45; col. 4, lines 24-40). **Zwirn further discloses "The video signal is an electronic image of the scene under focus" (col. 3, lines 40-41).** Zwirn discloses "the present invention relates to the field of automatic focusing systems and more particularly to the field of

automatic focusing systems driven by **scene information**" (col. 1, lines 5-10), particularly information relating to the high frequency spectral (edge) density of the scene (col. 1, lines 54-58), where it is apparent that a **scene could be an object focused by an imaging system.** Zwirn further discloses determining an optimum focus position by adjusting the focus position towards the focus position where the high frequency content increases thereby increasing the sharpness of the focus (optimum focus) (col. 1, lines 62-65; col. 2, lines 1-10, lines 41-45, col. 3, lines 50-60; col. 4, lines 35-39).

Zwirn further discloses "As the video information gathering device is brought into focus the high frequency content of the video signal will increase. By passing the video signal through a band pass filter and then processing it in a conditional integrator, a control signal is generated whose amplitude contains information relating to the degree of focus. The control signal is stored and later compared to a control signal derived from a subsequent scanning. Once a significant change in control signal levels is detected a drive signal is sent to the focusing device. If after being driven the subsequent scene has less high frequency (edge density) content, the a drive signal in the opposite polarity or direction is sent to the focusing device. In this manner the scene is toggled into focus only when the scene is initially defocused" (col. 1, lines 62-68 through col. 2, lines 1-10). It is clear from the above disclosure by Zwirn that a control signal which is a measure of edge density (high frequency components) of each scan (or image) of the scene (or object) at each different focus is computed and then according to the focus or scan position that has the greatest edge density (high frequency components) the optimum focus position is determined and thus a set of images (scans) of the scene are evaluated using edge density, thus Zwirn teaches comparing images with respect to edge density to automatically obtain optimum image focus position and thus selecting or using the optimum focus position as highly focused position to focus the imaging system optimally. The claim

only recites naming the optimum position as reference focus position without providing any other specifics in the claim 10 for what purpose it is being used and therefore it is assumed to be a choice of the inventor to name such position as a reference focus position.

Claim 11 recites "the method of claim 10, wherein the computed edge density is a relative measure of edges in each of the images". As discussed in the rejection of claims 1 and 2, Zwirn discloses the computed high frequency spectral (edge) density of the scene (object) is measured by measuring high frequency components (edges) in each of the images. Therefore, claim 11 has been similarly analyzed and rejected as per claims 10, 1-2.

Claim 12 recites "The method of claim 10, wherein the edge density is computed using an edge density metric employing one of any gradient-based and any non-gradient-based edge detection and image processing methods". As discussed in the rejection of claim 2, the video signal is passed through the band pass filter **15** to determine the degree of focus (edge density). Therefore, claim 12 has been similarly analyzed and rejected as per claims 10, 1-2 and 11.

Regarding claim 31, claim 31 recites " a method of automatically focusing an imaging system on an object comprising one or both of: either using a first focus position or adjusting a second focus position or both". Therefore, examiner selects using first focus position which being the position, which **corresponds to the object created by the imaging system** that has a greatest edge density as an optimum focus position for the imaging system. These limitations have discussed in the rejection of claim 10, where Zwirn clearly teaches that a focus position with greatest edge

density will define the optimum focused position and thus this position if used will optimally focus the imaging system, therefore claim 31 has been similarly analyzed and rejected as per claim 10.

Claims 32 and 33 has been similarly analyzed and rejected as per claims 10-12, and 31.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 1-2, 21, 23 and 26-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kitamura, U.S. Patent No. 5,369,430 further in view of Zwirn et al., U.S. Patent No. 4,789,898.

Claim 1 recites a method of automatically focusing an imaging system on an object comprising: using either

(a) **a comparison between an image of a typical object and the image of the object created by the imaging system,** or (b) **an edge density in an image of the object and the comparison,** to determine an optimum focus position.

Kitamura discloses an image of a typical object (reference image pattern – which is not being imaged by the imaging system but is pre-stored) (col. 2, lines 64-68) and further discloses a comparison between an image of a typical object and the image of the object created by the imaging system to

determine an optimum focus position (col. 3, lines 1-20; col. 2, lines 1-16; figure 1) which conforms to the limitation (a) as recited in claim 1.

However, regarding limitation (b) in claim 1, where an edge density in an image of the object and the comparison are to determine an optimum focus position, examiner asserts that "A person using a camera or microscope can determine the optimal or sharp focus by looking at the focused image and then based on his/her capability of viewing image appropriate sharpness or focusing can be selected" or "a person by just looking at two images taken at different focus settings can determine or select the best focused image". But the same problem of obtaining a focused image automatically using an image processing system or a computer system is totally different. A computer system cannot determine the optimal or sharp focus by just looking at the focused images as done by a human operator, but it has to perform some calculations on the image data by considering image characteristics such as measuring high frequency components (edge density) in an image which is well-known to determine the best focus. It is well known in the art that a focus is measured in terms of the sharpness of an image and such a sharpness of an image is measured by measuring the high-frequency components in the image, and thus when two images are compared by the system, it's actually the image characteristics such as high-frequency components that are compared, therefore image comparison when done automatically to obtain an optimum focus, the image characteristics such as edge density are automatically used by the system. Kitamura does teach of comparing or correlating **the focus** of an image imaged by the imaging system with that of an typical object image (reference image) to obtain optimal (in-state) focus, thus comparing the images but does not expressly teach the details such as focus being the function of edge density (high frequency components) in the image. Thus, it would be obvious for one of ordinary skill in the art to

perform image comparison with respect to edge density to automatically determine the optimum focus position.

However, for the sake of throwing more light into this well known art teachings, examiner cites Zwirn. Zwirn teaches comparing video image signals (control signals), which are related to image characteristics such as edge density to determine an optimum focused image (col. 2, lines 20-45; col. 4, lines 24-40). **Zwirn further discloses "The video signal is an electronic image of the scene under focus" (col. 3, lines 40-41).** Zwirn discloses "the present invention relates to the field of automatic focusing systems and more particularly to the field of automatic focusing systems driven by **scene information**" (col. 1, lines 5-10), particularly information relating to the high frequency spectral (edge) density of the scene (col. 1, lines 54-58), where it is apparent that a **scene could be an object focused by an imaging system.** Zwirn further discloses determining an optimum focus position by adjusting the focus position towards the focus position where the high frequency content increases thereby increasing the sharpness of the focus (optimum focus) (col. 1, lines 62-65; col. 2, lines 1-10, lines 41-45, col. 3, lines 50-60; col. 4, lines 35-39).

Zwirn further discloses "As the video information gathering device is brought into focus the high frequency content of the video signal will increase. By passing the video signal through a band pass filter and then processing it in a conditional integrator, a control signal is generated whose amplitude contains information relating to the degree of focus. The control signal is stored and later compared to a control signal derived from a subsequent scanning. Once a significant change in control signal levels is detected a drive signal is sent to the focusing device. If after being driven the subsequent scene has less high frequency (edge density) content, the a drive signal in the opposite polarity or direction is sent to the focusing device. In this manner the scene is toggled into focus only when the scene is initially defocused" (col. 1, lines 62-68 through col. 2, lines

1-10). It is clear from the above disclosure by Zwirn that a control signal which is a measure of edge density (high frequency components) of each scan (or image) of the scene (or object) at each different focus is computed and then each image (or scan) is compared to another to determine the optimum focused image, thus Zwirn teaches comparing images with respect to edge density to automatically obtain optimum image focus position. Therefore, it would have been obvious for one of ordinary skill in the art at the time of invention was made to combine Kitamura's and Zwirn's teachings because both references belong to the same field of endeavor and both references provide automatic focusing using image comparison and Zwirn provides a well-known detailed teaching of focus being the function of sharpness and sharpness being the function of high frequency components and using high frequency components in the images for image comparison to obtain a optimum focus position which is totally image or scene based, of which Kitamura does not provide explicit (detailed) teachings and Zwirn further teaches the selection of image such that highest frequency components in the image represent a highly focused image.

Claim 2 recites "the method of claim 1, wherein using an edge density in an image of the object comprises: computing the edge density of each image of a set of images of the object; and using a focus position corresponding to an image of the set having a greatest edge density as the optimum focus position". Zwirn further discloses "As the video information gathering device is brought into focus the high frequency content of the video signal will increase. By passing the video signal through a band pass filter and then processing it in a conditional integrator, a control signal is generated whose amplitude contains information relating to the degree of focus. The control signal is stored and later compared to a control signal derived from a subsequent scanning. Once a significant change in control signal levels is detected a drive signal is sent to the focusing device. If

after being driven the subsequent scene has less high frequency (edge density) content, then a drive signal in the opposite polarity or direction is sent to the focusing device. In this manner the scene is toggled into focus only when the scene is initially defocused" (col. 1, lines 62-68 through col. 2, lines 1-10). It is clear from the above disclosure by Zwirn that a control signal which is a measure of edge density (high frequency components) of each scan (or image) of the scene (or object) at each different focus is computed and then according to the focus or scan position that has the greatest edge density (high frequency components) the optimum focus position is determined and thus a set of images (scans) of the scene are evaluated using edge density.

Regarding claim 21, Kitamura discloses an imaging system that recites a memory, program (inherent to be used by CPU) and a CPU (controller) (col. 5, lines 10-45). All other limitations have been similarly analyzed and rejected as per claim 1.

Regarding claim 23, all limitations have been similarly analyzed and rejected as per claims 21, 1 and 10.

Regarding claim 26, Kitamura discloses an imaging system that recites a memory, program (inherent to be used by CPU) and a CPU (controller) (col. 5, lines 10-45). All other limitations have been similarly analyzed and rejected as per claim 1.

Regarding claim 27, all limitations have been similarly analyzed and rejected as per claims 26, 1 and 10.

8. Claim 25 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kitamura, U.S. Patent No. 5,369,430 further in view of Zwirn et al., U.S. Patent No. 4,789,898, and further in view of Rooks et al., IEEE, June 5, 1999, "Development of an inspection process for ball-grid-array technology using scanned-beam x-ray laminography".

Claim 25 recites "the image system of claim 21 being an x-ray laminography system". Kitamura and Zwirn both does not disclose the image system being an x-ray system, but Kitamura discloses semiconductor inspection using automatic focusing (col. 1, lines 8-13) and Zwirn as discussed in the rejection of claim 1 teaches "the present invention relates to the field of automatic focusing systems and more particularly to the field of automatic focusing systems driven by **scene information**" (col. 1, lines 5-10). Rooks teaches that in order to inspect the eutectic-solder fillets of BGA joints using an X-ray system, **the system must be able to focus on a particular horizontal cross-sectional plane** and, therefore, isolate the solder fillets from the solder balls and Rooks further teaches Scanned-beam x-ray laminography (SBXLAM) which is the only **automated** solder inspection system which is capable of focusing on a horizontal plane to examine features within the plane with great detail and contrast (page 851, right col., last para. through page 852, left col.). Therefore, it would have been obvious for one of ordinary skill in the art to use the automatic focusing as taught by combined invention of Zwirn and Kitamura in the X-ray laminography system of Rooks because Zwirn teaches "the present invention relates to the field of automatic focusing systems and more particularly to the field of automatic focusing systems driven by **scene information**" which is also applicable to Rooks, as Rooks wants to isolate the **solder fillets from the solder balls** (scene information) by using system that is able to focus on a particular horizontal cross-sectional plane as discussed before, which is scene driven focusing and Kitamura discloses semiconductor inspection which is also applicable to Rooks. Further Rooks teaches automated

system, from which it is clear the focus is automatically performed by system and further support is provided by Rooks on page 860, right column, first paragraph.

Claim 30 has been similarly analyzed and rejected as per claims 26, 25, 1 and 2.

Allowable Subject Matter

Reasons of Allowance:

9. Claims 5-9, 15-20 and 34-35 are allowed.

The following is an examiner's statement of reasons of allowance:

The instant invention relates to a method of determining a change in focus position of an imaging system. The prior art of record (Kitamura, U.S. Patent No. 5,369,430) does teach obtaining the optimal focused image by comparison between an image of a typical object and an image of the object created by the imaging system but does not teach "adjusting a second focus position corresponding to an image of the object by a difference between focus positions for a reference image of a typical object and an image of the typical object that closely matches the image of the object, where the first focus position corresponds to a reference image of a typical object, the second focus position corresponding to an image of the typical object that closely matches the image of the object" as recited in claims 5, 34 and 35. Therefore claims 5, 34 and 35 are allowed and all other claims depending on claims 5, 34 and 35 are allowed at least by dependency on claims 5, 34 and 35.

The invention method further comprises comparing the image of the second object to the images in the set of images of the first object to find a closest matching image, the closest matching image from the set having an associated third focus position; and determining a change in the second focus position to provide an optimum focus position for imaging the second object with the imaging system where the object being representative of a class of objects. These features in combination with the other elements of the claim 15 are not disclosed or suggested by the prior art of record. Therefore claim 15 is allowed and all other claims depending on claim 15 are allowed at least by dependency on claim 15.

10. Claims 3, 4, 14, 22, 24, 28 and 29 are objected to as being dependent upon a rejected base claim but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is an examiner's statement of reasons of allowance:

The same reasons of allowance are applied to claims 3, 4, 14, 22, 24, 28 and 29 as applied to claims 5 and 15.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Manav Seth whose telephone number is (571) 272-7456. The examiner can normally be reached on Monday to Friday from 8:30 am to 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh Mehta, can be reached on (571) 272-7453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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Manav Seth
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June 1, 2006